

Appl. No. 10/743,979
Amdt. dated 06/22/05
Response to Office Action of 03/25/2005

Attorney Docket No.: N1085-00258
TSMC2003-0898

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

- 1 1. (Currently Amended) A method for reducing copper corrosion in a semiconductor device comprising:
 - 3 providing a semiconductor substrate with a Cu-containing conductive material formed thereon and a film directly interposed between said Cu-containing conductive material and the environment; and
 - 6 cleaning said semiconductor substrate using a substantially ozone-free DI water clean operation that includes rotating said semiconductor substrate at a spin speed no greater than 350 rpm.
- 1 2. (Original) The method as in claim 1, wherein said providing includes performing an etch operation that exposes said film and includes using a patterned photoresist layer as an etch mask, and said cleaning said semiconductor substrate further comprises removing portions of said photoresist layer.
- 1 3. (Original) The method as in claim 2, wherein said cleaning said semiconductor substrate further comprises stripping said photoresist layer using a plasma prior to said using a DI water clean operation.
- 1 4. (Cancelled)
- 1 5. (Currently Amended) The method as in claim [[4]] 1, wherein said film comprises an etch stop film and said providing comprises performing an etch operation comprises etching that etches a dielectric layer formed over said etch stop film and exposes said etch stop film.

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- 1 6. (Original) The method as in claim 5, wherein said etch stop film is disposed
2 directly beneath said dielectric layer.
- 1 7. (Original) The method as in claim 5, wherein said etching a dielectric layer is
2 part of a dual damascene dry etching process sequence.
- 1 8. (Original) The method as in claim 5, wherein said dielectric layer includes at
2 least one of a layer of carbon-containing material, a layer of nitrogen-containing material
3 and a layer of fluorine-containing material.
- 1 9. (Original) The method as in claim 1, wherein said Cu-containing conductive
2 material comprises substantially pure copper.
- 1 10. (Original) The method as in claim 1, wherein said film comprises one of SiN,
2 SiC, SiOC, and SiCN.
- 1 11. (Original) The method as in claim 1, wherein said film includes a thickness
2 ranging from 400 to 800 angstroms.
- 1 12. (Original) The method as in claim 1, wherein said cleaning includes rotating said
2 semiconductor substrate at a spin speed of at least 150 rpm during said DI water clean
3 operation.
- 1 13. (Original) The method as in claim 1, wherein said semiconductor substrate is
2 approximately 300mm in diameter and said spin speed lies within the range of 180 to
3 250 rpm.
- 1 14. (Original) The method as in claim 1, wherein said semiconductor substrate is
2 approximately 200 mm in diameter and said spin speed lies within the range of 200 to
3 300 rpm.

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1 15. (Original) The method as in claim 1, wherein said cleaning further includes
2 cleaning said semiconductor substrate using an in-situ organic cleaning operation, an
3 aqueous chemical cleaning operation or a DI water/ozone cleaning operation, prior to
4 said using a DI water clean operation.

1 16. (Original) The method as in claim 15, wherein said in-situ organic cleaning
2 operation, aqueous chemical cleaning operation or DI water/ozone cleaning operation
3 comprises an organic cleaning operation using an organic solvent that contains fluorine.

1 17. (Original) The method as in claim 1, further comprising performing an in-situ
2 drying operation by spin drying said semiconductor substrate.

1 18. (Original) The method as in claim 17, wherein said spin drying includes air or
2 nitrogen as a gaseous medium.

1 19. (Original) The method as in claim 1, wherein said DI water clean operation
2 includes nitrogen or air as an ambient medium.

1 20. (Original) The method as in claim 1, wherein said cleaning comprises
2 individually cleaning said semiconductor substrate in a tool that processes
3 semiconductor substrates individually.

1 21. (New) A method for reducing copper corrosion in a semiconductor device
2 comprising:

3 providing a semiconductor substrate with a Cu-containing conductive material
4 formed thereon;

5 performing an etch operation that exposes an etch stop film directly interposed
6 between said Cu-containing conductive material and the environment; and

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7 cleaning said semiconductor substrate using a DI water clean operation that
8 includes rotating said semiconductor substrate at a spin speed no greater than 350 rpm.

1 22. (New) A method for reducing copper corrosion in a semiconductor device
2 comprising:

3 providing a semiconductor substrate with a Cu-containing conductive material
4 formed thereon and a film directly interposed between said Cu-containing conductive
5 material and the environment, wherein the film comprises one of SiN, SiC, SiOC and
6 SiON; and

7 cleaning said semiconductor substrate using a DI water clean operation that
8 includes rotating said semiconductor substrate at a spin speed no greater than 350 rpm.